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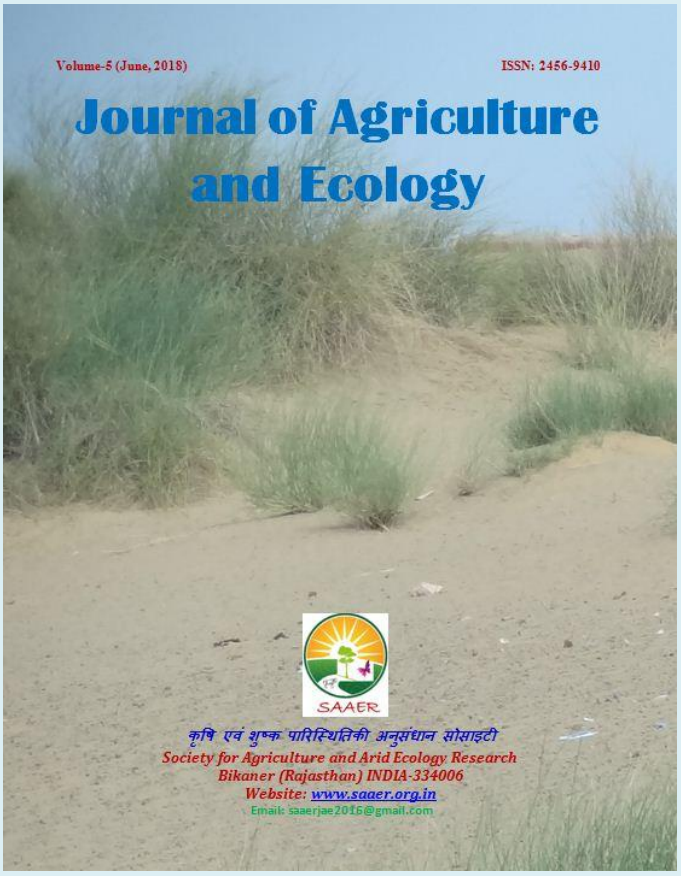

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Study of variability and heritability in coriander (*Coriandrumsativum* L.) genotypes under normal and limited moisture stress condition

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Abstract
Drought is very common adverse environmental factor limiting crop production in most of the tropical and subtropical regions of India, thus limiting up productivity. Limited moisture stress is the major constraint in productivity. To generate information on the effect of moisture stress on various traits which contribute for yield would be helpful in developing tolerant coriander genotypes. The result revealed that plant height; umbels per plant and biological yield per ten plants are most important yield component character in limited moisture condition.

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Introduction

Coriander (*Coriandrum sativum* L., 2n=22) is an important seed spice crop belonging to family Apiaceae and is highly cross-pollinated. It is probably one of the earliest seed spices known to mankind (Pruthi 1976). The major problems in coriander breeding are limited genetic variability for yield and related characters and non-availability of resistance against stem gall, powdery mildew and wilt. Coriander is cultivated in two specific agro-ecological conditions *viz.*, irrigated and rainfed. In the areas where the crop is cultivated rainfed, erratic rainfall causes severe moisture stress conditions are faced, thus the productivity, as a consequence is less. In India, majority of the crop is still depended on rainfall and conserved moisture. Drought is a very common adverse environmental factor limiting crop production in most of the tropical and subtropical regions of India, thus limiting up productivity (Muthusamy et al. 2017; Samadia & Haldhar 2017). Collection and evaluation of germplasm having adequate variability and study of genetic variability, heritability and genetic advance for economically important characters is the first essential requirement of successful breeding programme for selection of superior genotypes and improvement of any traits. Moreover, knowledge of heritability is essential for selection-based improvement as it indicates the extent of transmissibility of a character in

future generations (Verma et al. 2015; Singh et al. 2016). Hence, the present study was, taken up to study variability, heritability and genetic advance among genotypes of coriander under normal and limited moisture condition.

Materials and Methods

The present investigation was carried out at Research Farm S.K.N. College of Agriculture, Jobner with 20 elite genotypes of coriander which were randomly selected from the germplasm collection of AICRP on Spices located at S.K.N. College of Agriculture, Jobner. The experimental material was evaluated in Randomized Block Design with three replications in two environments namely, (i) normal and (ii) limited moisture condition. In normal condition all the standard Horticultural practice were followed to raise the good and healthy crop in normal environment. Whereas in limited moisture condition oneirrigation was given at the time of sowing and one light irrigation after 8 days was given to ensure proper germination. After that no irrigations were given. In each environment/replication, each genotype was sown in a plot size of 2.0 x 0.9 m^2 consisting of three rows. The row to row and plant to plant distance was 30 cm and 10 cm, respectively. Observations were recorded on ten characters *viz.*, Days to 50 per cent flowering, plant height (cm), branches per plant, umbels per plant, umbellates per umbel, seeds per umbel, 1000-seed weight (g), biological yield per ten plants (g), volatile oil content (%) and seed yield per ten plants (g) in each entry and in each replication in both the two sowing conditions. The data obtained in this study were subjected to appropriate statistical analysis. Pooled analysis of variance was carried out to know the genotype x environment interaction. The expected genetic advance for each character was calculated according to the formulae suggested by Johnson et al. (1955).

Results and Discussion

The analysis of variance revealed that significant variability was present in the genotypes for most of the characters under normal and limited moisture condition. This suggested that the material had adequate variability and response to selection may be accepted in the breeding programme for seed yield or any of its supporting characters (Table 1, 2 & 3). These results are in agreement with the findings of Mathur et al. (1971) in coriander in normal and moisture stress conditions. The replication mean square were also significant for the characters *viz.*, umbels per plant, umbellates per umbel, 1000-seed weight and volatile oil content in normal condition and umbels per plant, umbellates per umbel, 1000-seed weight, volatile oil content and biological yield in limited moisture condition indicating their sensitivity to the environment. Changes in the means of character in limited moisture condition in comparison to normal condition were noted. Mean values were higher in normal condition in comparison to limited moisture condition for the characters *viz.*, plant height, seeds per umbel, 1000-seed weight, biological yield and seed yield per plant. Volatile oil content had higher mean value in limited moisture condition in comparison to normal condition. This indicated clearly the adverse effect of

moisture stress on the character expression by the genotypes. The mean values of character days to 50% flowering, branches per plant, umbels per plant, umbellates per umbel and volatile oil content varied little across environmental conditions.

The estimates of coefficients of variations were in general higher in stress environment than in normal. In both environment high estimates of variation were observed for traits *viz.*, days to 50% flowering, plant height, branches per plant, umbels per plant, seeds per umbel, 1000-seed weight, volatile oil content and seed yield, thus selection may be more effective for these characters because the response to selection is directly proportional to the variability present in the experimental material. Low estimates of variation were observed for umbellets per umbel in normal condition, which indicated that selection might not be effective for these characters. Similar results were reported by Patel & Aglodia (2007) in coriander. Comparison among the characters indicated that GCV and PCV values varied little across environments for days to 50% flowering, branches per plant, 1000 seed weight, volatile oil content and seed yield. For characters plant height, umbellates per umbel, seeds per umbel and biological yield the GCV and PCV values were of higher magnitude in limited moisture stress condition.

Table 1. Pooled ANOVA for different characters of coriander genotype evaluated under normal (C_1) and limited moisture (C_2) conditions

S. No.	Characters	Source of variation with d.f.				
		E 1	R 4	G 19	E x G 19	*Error* 76
1.	Days to 50% flowering	598.53**	11.01	556.78**	18.71	11.77
2.	Plant height (cm)	4575.67**	9.67	13.74**	48.76	26.18
3.	Branches per plant	6.67	0.24	6.03	0.17	0.24
4.	Umbels per plant	408.85**	55.70	22.47	6.32	7.17
5.	Umbellets per umbel	32.67	1.31	0.86	0.13	0.14
6.	Seeds per umbel	1668.80**	11.32	225.32**	45.34	16.78
7.	1000-seed weight (g)	103.73	0.89	23.80	4.59	0.14
8.	Volatile oil content (%)	0.04	0.00	0.02	0.01	0.00
9.	Biological yield (g)	10982.53**	215.53**	1165.74**	448.04**	94.34
10.	Seed yield (g)	2726.53**	27.17	200.19**	81.62**	32.02

* and ** refers to significant at P = 0.05 and P = 0.01, respectively

Table 2. Mean, range, coefficients of variation, heritability (broad sense) and genetic advance for yield and other attributes (normal condition)

S. No.	Characters	Mean	Range	Coefficients of variation			Heritability % (bs)	GA as %age of mean
				Environment	Genotypic	Phenotypic		
1.	Days to 50% flowering	68.70	54.00-88.00	4.70	14.36	15.10	90.33	28.11
2.	Plant height (cm)	59.99	51.43-67.20	8.68	5.62	10.34	29.58	6.30
3.	Branches per plant	6.27	4.43-8.43	7.97	15.49	17.42	79.08	28.38
4.	Umbels per plant	18.14	14.20-24.47	16.16	8.53	18.37	22.59	8.55
5.	Umbellates per umbel	5.47	4.60-6.10	8.15	4.96	9.54	27.05	5.31
6.	Seeds per umbel	39.37	27.63-52.53	10.26	15.29	18.42	68.97	26.17
7.	1000-seed weight (g)	13.59	9.22-17.52	3.24	17.32	17.62	96.61	35.07
8.	Volatile oil content (%)	0.29	0.17-0.42	9.078	18.97	21.03	81.37	35.25
9.	Biological yield (g)	89.28	60.00-122.67	11.74	17.85	21.36	69.81	30.72
10.	Seed yield (g)	41.32	29.00-56.67	14.75	15.83	21.64	53.53	23.86

Table 3. Mean, range, coefficients of variation, heritability (broad sense) and genetic advance for yield and other attributes (limited moisture condition)

S. No.	Characters	Mean	Range	Coefficients of variation			Heritability % (bs)	GA as %age of mean
				Environment	Genotypic	Phenotypic		
1.	Days to 50% flowering	73.17	56.00-90.67	4.96	12.73	13.66	86.85	24.43
2.	Plant height (cm)	47.64	32.20-56.23	10.55	11.24	15.42	53.14	16.88
3.	Branches per plant	5.80	3.97-7.73	8.41	16.90	18.88	80.15	31.18
4.	Umbels per plant	14.45	9.87-17.37	16.58	10.51	19.63	28.69	11.60
5.	Umbellates per umbel	4.43	3.73-5.20	6.82	9.04	11.32	63.77	14.87
6.	Seeds per umbel	31.91	18.77-44.50	13.01	20.50	24.28	71.28	35.66
7.	1000-seed weight (g)	11.43	8.68-16.67	2.75	17.63	17.85	97.63	4.10
8.	Volatile oil content (%)	0.33	0.23-0.48	7.77	20.42	21.85	87.34	39.31
9.	Biological yield (g)	70.15	29.33-106.67	12.66	21.19	24.69	73.71	37.48
10.	Seed yield (g)	31.78	15.00-41.67	16.32	17.19	23.69	52.55	25.64

If heritability of a character is high (> 60%), selection for such a charactersbecomes fairly easy. This is because there would be close correspondence between genotypic and phenotypic variation due to a relatively smaller contribution of environment to the phenotype, but for a character with a low heritability (< 40%), selection may be considerably difficult or virtually impractical due to masking effect of environment on the genotypic effect.In present investigation broad sense heritability was observed to be high for days to 50% flowering, branches per plant, seeds per umbel, 1000-seed weight, volatile oil content and biological yield in normal and for most of the characters except plant height, seed yield and umbels per plant in limited

moisture condition, which is in agreement with earlier reports of Patel & Agalodia (2007) for umbels per plant, 1000-seed weight and essential oil in coriander. While the estimates of heritability changed very little between the environments for traits –branches per plant, 1000-seed weight, biological yield and seed yield. The change was considerable for plant height and umbellates per umbel. The estimates were higher in the stress environment.Heritability estimates alone do not provide information on the amount of genetic progress that would result from the selection of the best genotype. Therefore, genetic advance as percentage of mean was calculated in order to determine the relative merits of different characters that can be further utilized in the selection programme.

In normal condition high magnitude of genetic advance as percentage of mean was obtained for 1000-seed weight, volatile oil content and biological yield which is in agreement with earlier reports of Patel & Agalodia (2007) for volatile oil content and 1000-seed weight in coriander. Moderate genetic advance as percentage of mean was observed for days to 50% flowering, branches per plant, seeds per umbel and seed yield per plant which is in agreement with the reports of Bhandari & Gupta (1991) for seeds per umbel in coriander. Low magnitude genetic advance as percentage of was observed for plant height, umbels per plant and umbellates per umbel. These results are in accordance with the earlier report of Jain et al. (2002) in coriander. In normal condition, 1000 seed weight, volatile oil content and biological yield had high heritability along with high genetic advance as percentage of mean.Whereas, in limited moisture condition character *viz*,volatile oil content, biological yield, seeds per umbel and branches per plant had high heritability along with high genetic advance as percentage of mean which indicated that these characters are governed by additive gene action and selection of these characters would be effective. The character days to 50% flowering had high heritability with moderate genetic advance as percentage of mean. Comparison of the genetic advance estimates between the environments indicated that minimum changes in the estimates were observed for traits- branches per plant and seed yield. While the changes were considerable for traits-plant height, umbellates per umbel, seeds per umbel, 1000-seed weight and biological yield while in traits plant height, umbellates per umbel, seeds per umbel and biological yield, the estimates increased in stress in comparison to normal environment. The estimate was lower in 1000-seed weight in stress in comparison to normal environment. Seed yield per plant had moderate heritability and genetic advance as percentage of mean. Plant height, umbellets per umbel and 1000-seed weight had high heritability and low genetic advance as percentage of mean. Umbels per plant had low heritability with low genetic advance as percentage of mean. This indicates the influence of non-additive gene action and considerable influence of environment on the expression of these traits. These traits could be exploited through manifestation of dominance and epistatic components through heterosis breeding. Hence, the breeder should adopt suitable breeding methodology to utilize both additive and non-additive gene effects

simultaneously (Verma et al., 2015). Since yield is a multiplicative character dependent on its component characters, direct selection for yield may not be that effective as the one based on its component characters. In the present investigation,biological yield had high estimates of PCV, GCV, heritability and genetic advance as percentage of mean in both environments. Hence, it is suggested that major emphasis should be given on such characters for further improvement.

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